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The Security of Oil Supplies: Heightened Risks in the 1990s [redacted] 25X1

A Research Paper

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February 1987

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The Security of Oil Supplies: Heightened Risks in the 1990s

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A Research Paper

This paper was prepared by

the Office of Global Issues.

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Comments and queries are welcome and may be directed to the Chief, Strategic Resources Division, OGI

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The Security of Oil Supplies: Heightened Risks in the 1990s

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Summary

Information available as of 15 October 1986 was used in this report.

The Western world is clearly heading toward a greater dependence on Persian Gulf oil and a greater vulnerability to a cutoff of supplies from the region. The oil price collapse already has reversed several market trends and, if sustained, will increase demand for Persian Gulf oil in the years ahead. Higher oil consumption and lower supplies from non-OPEC producers are likely in the future as long as prices remain low. In 10 years, 40 percent of Western oil supplies may come from the Persian Gulf, and an even greater share of oil production capacity will be located in the region.

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Any long-term outlook for the oil market is prone to uncertainties regarding economic growth, producer behavior, investment levels, and actions by oil consumers. To bound likely conditions in 1995, we examined two scenarios that reflect the general range of thinking in oil companies, consulting firms, and international organizations:

- In one scenario, we assume oil prices rise slowly to $20 per barrel in 1995 and non-Communist economic growth averages 3 percent per year. Prices stay relatively low because OPEC producers are unable to restrain output. With low oil prices, investment to develop new non-OPEC oil supplies falters.

- In the other scenario, world oil prices are assumed to rise steadily to roughly $30 by 1995 and this slows economic growth somewhat. Higher prices reflect improved OPEC production discipline; conservation and substitution away from oil continue, and non-OPEC supplies are relatively stable.

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Projections based on these alternate assumptions suggest that non-Communist oil demand is likely to increase by 3-7 million barrels per day (b/d) by 1995. Non-OPEC supplies are expected to decline by as much as 5 million b/d from current levels, leading to significantly higher demand for OPEC oil by 1995—22-30 million b/d, compared with about 17.6 million b/d in 1985.

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Although supplies will be ample to cover the range of projected demand, surplus capacity will erode over the decade. OPEC capacity will grow to 30-33 million b/d, with 21-25 million b/d located in the Persian Gulf. This will represent about 40 percent of total Western capacity. Because

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demand is likely to grow faster than supplies, however, non-Communist surplus capacity is projected to fall under both scenarios examined, from about 10 million b/d in 1985 to 3-8 million b/d by 1995.

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Although these projections indicate no supply imbalance in general, they clearly suggest a heightened vulnerability to possible supply disruptions. Energy supply disruptions have occurred frequently in the past, and we believe the probability that disruptions will occur again in the future is high. Economic problems, political disaffection, Islamic fundamentalism, and terrorism will pose constant threats to political stability in the Persian Gulf region, the site of one-fourth of non-Communist production and about 60 percent of reserves.

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While supply disruptions can take many forms, we have analyzed two particular disruption cases in order to illustrate the implications for US energy security in the mid-1990s:

- The first case is a moderate disruption where 5 million b/d of productive capacity is lost for six months, about the size of some past disruptions. Events that could lead to such a loss include war damage to important facilities in several key producing countries, political change in Saudi Arabia, or increased Iranian influence over Gulf supplies.

- The second case is an extreme scenario, where a major disruption leads to the loss of about 14 million b/d of productive capacity for about six months. This case, which is considerably more severe than any disruption to date, represents the almost complete loss of Middle East oil supplies.

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Our analysis indicates that surplus capacity in 1990 could completely offset the loss of oil supplies under a moderate disruption if trends in oil prices and economic growth stay within the ranges we examined. A major disruption, however, would lead to a net production shortfall, ranging from 5-9 million b/d. By 1995 even a moderate disruption could cause as much as a 2-million-b/d net shortfall in production, and a major disruption as much as 11 million b/d.

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Net production shortfalls can be dealt with through a combination of responses. The most effective is the use of strategic, government-controlled oil stockpiles. The US Strategic Petroleum Reserve, for example, currently could be drawn down at a rate of 2.3 million b/d over a three-month period, and at gradually decreasing rates thereafter. Foreign government–controlled stocks are sufficient to provide additional supplies of about 1 million b/d for up to six months:

- With drawdown of strategic stocks, the production shortfall from a moderate disruption could be covered even in 1995.
- Strategic stocks would be able to cover only a part of the net production shortfall in a major disruption. Fuel switching and demand restraint, encouraged either by high prices or policy directives, would be needed to close the remaining gap.

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From our analysis, it appears that strategic stocks are essential to constrain the impacts of a disruption similar to the largest we have experienced in the past. Larger disruptions, however, are likely to exceed the capabilities of the excess capacity and strategic stocks that will probably exist by the mid-1990s. In these cases, oil demand would have to be cut, perhaps significantly, and economic activity would suffer as a result.

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Scope Note

This paper was undertaken in 1986 to support a Department of Energy assessment of US and non-Communist world energy security.

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The Security of Oil Supplies: Heightened Risks in the 1990s

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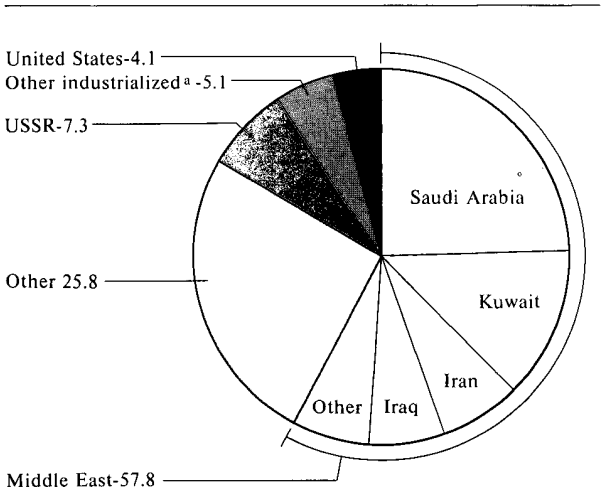
Introduction

Last year's oil price collapse could set the stage for increased US energy vulnerability. If conditions conducive for market control—especially strong growth in oil demand, little growth in non-OPEC supplies, and eroding surplus capacity—are sustained, OPEC, or a group of key oil exporters in the Persian Gulf area, is likely to regain important influence over the oil market in the 1990s. Because of the high concentration of oil reserves and the bulk of non-Communist surplus oil production capacity in the Persian Gulf region, oil consumers could face a period of increased reliance on this volatile area and greater vulnerability to an oil supply disruption (figure 1).

Figure 1
World Crude Oil Reserves, 1986



[a] Countries included are Western Europe, Canada, Japan, Australia, and New Zealand.

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Import Dependence Versus Vulnerability

The United States is energy dependent because we import oil in a single, integrated market that relies on a few countries in one region—the Persian Gulf—for a significant portion of energy supplies. By itself, however, dependence does not create vulnerability. Vulnerability requires a risk of a supply disruption large enough to cause significant economic dislocations. Vulnerability is also the susceptibility to the use of oil as a political weapon.

In case of either a disruption or deliberate supply cutoff, our ability to avoid economic upheaval by offsetting lost supplies is determined by several factors:

- Availability of surplus oil productive capacity in countries not affected by the disruption.
- Availability of strategic oil stocks.
- Ability to use alternative fuels and restrain demand in the absence of a price runup.

The volatile situation in the Persian Gulf creates considerable risk to oil flows, but US vulnerability is currently relatively low because of a relative abundance of alternative supplies.

A Historical Perspective

Major oil disruptions in the past illustrate how varying degrees of oil import dependence, supply disruptions, and the use of market offsets affect the extent of our energy vulnerability:

- *The Arab Oil Embargo.* The non-Communist world's dependence on Persian Gulf oil increased gradually during the late 1950s and 1960s, and by 1973 Arab oil producers accounted for 40 percent of total non-Communist world oil production. With the

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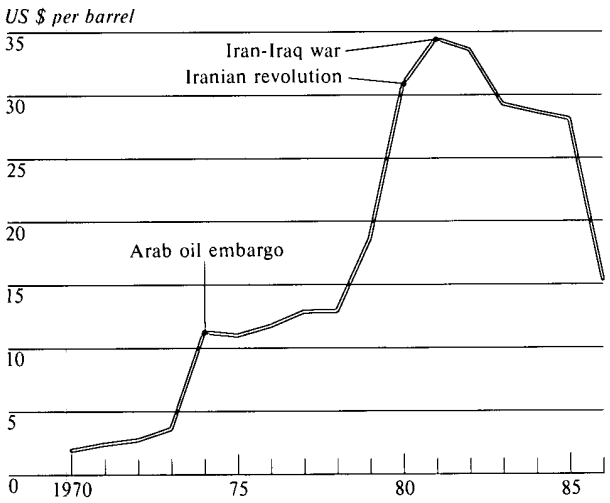
Figure 2
Average World Oil Prices, 1970-86



outbreak of the Arab-Israeli war in 1973, the Arab producers wielded the "oil weapon," causing oil prices to more than triple. The embargo and production cutback were perceived as a threat to our national security because few offsets were available to replace the lost oil supplies in the short term (figure 2).

- *The Iranian Revolution.* Despite concerns raised by the Arab oil embargo, world dependence on Persian Gulf oil continued to grow in the late 1970s, rising to 45 percent of non-Communist output by 1979. The revolution in Iran led to a temporary halt in Iranian exports and was perceived as a threat to the free flow of oil from other Persian Gulf countries as well. Although some offsets were available, they were insufficient to overcome dislocations and to deal with the huge precautionary and speculative commercial inventory buildup that began in early 1979. As a result, oil prices tripled between spring 1979 and 1981.

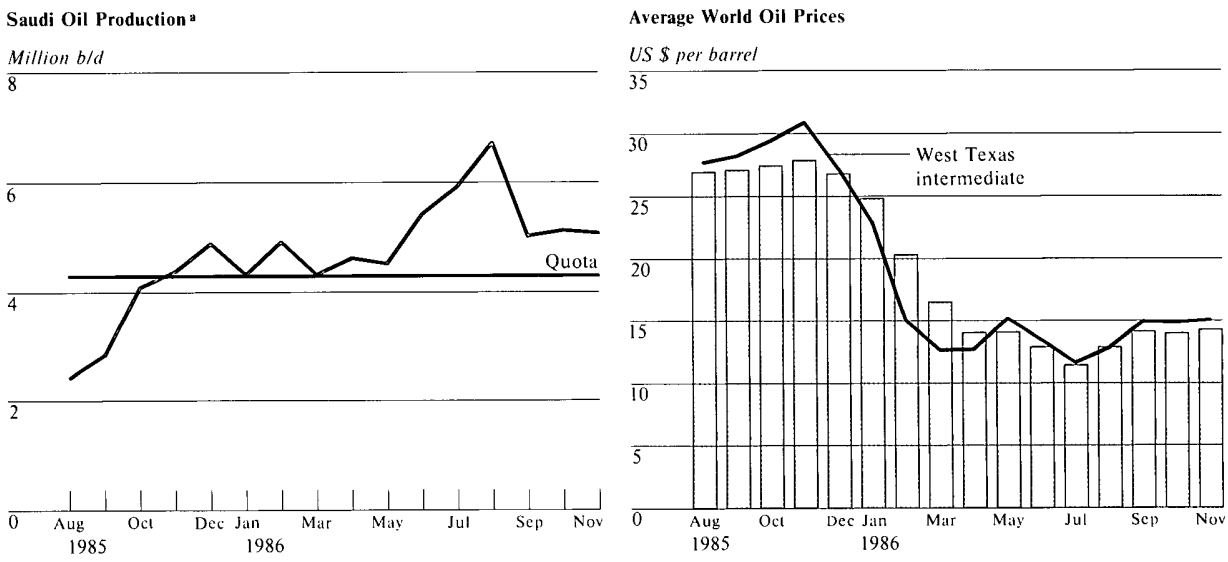
- *The Iran-Iraq War.* At the outbreak of the Iran-Iraq war in September 1980, Persian Gulf output was still about 40 percent of non-Communist supplies. The war caused a temporary cessation in Iranian and Iraqi oil exports and again generated concerns that other Persian Gulf exports would be disrupted. In contrast to previous disruption cases, excess production capacity, adequate oil stocks, and falling consumption kept price increases to a minimum; and a significant energy crisis was averted.

- *The Current Gulf Situation.* Dependence on Persian Gulf oil has declined since 1979, and the region now provides about 25 percent of the non-Communist oil supply. The Iran-Iraq war is now in its seventh year, frequent attacks on oil tankers and the potential for terrorism and sabotage remain problems throughout the Middle East and raise the risk of a supply disruption. Nevertheless, US vulnerability is relatively low because of our substantial response capability. There is considerable excess capacity in most fuels. Surplus oil production capacity alone totals about 10 million barrels per day (b/d)—although the vast majority is in the Persian Gulf. In addition, the United States and other International Energy Agency countries have increased their strategic oil stocks and continue to refine their approach for implementing the 1984 agreement to coordinate stock drawdowns and other activities in the event of a disruption. [redacted] 25X1 25X1

OPEC's Market Influence and Production Strategy

If the oil market trends set in motion this year continue, OPEC members or some group—primarily the Persian Gulf producers—are likely to regain important influence over the oil market by the 1990s. Consumers may again face surplus capacity levels and price pressures similar to the mid-1970s, with an even greater share of production and capacity concentrated in the Persian Gulf. The decline in surplus capacity outside the Gulf and growing market share of Gulf producers will strengthen their ability to manipulate prices again, at least in the short term, and increase the potential impact of a supply disruption. The policy objectives of key oil-producing nations in the Persian

Figure 3
Saudi Oil Production and Average World Oil Prices, August 1985-November 1986



[a] Includes Neutral Zone production.

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Gulf region will play a large role in determining whether recent trends continue, as well as how the market responds to future price pressures. [redacted]

The concentration of surplus capacity and oil reserves in the Middle East could lead to a more homogeneous OPEC, with a greater view toward ensuring the long-term importance of its oil wealth through lower but steadily rising prices. As long as the Iran-Iraq war continues, most industry observers do not foresee a significant shift in the current internal power structure of OPEC, therefore its policy priorities will continue to mirror Saudi Arabia's. A shift in the balance of power within the Persian Gulf region could lead to a formation of a new group with more common interests that conform more closely to Arab and Islamic causes, raising the risk that the group would again be willing to use the oil weapon to wield economic leverage at some future time. A clear Iranian victory in the war, considered an unlikely but significant possibility at present, could significantly alter the way Middle Eastern oil producers approach the oil market. Tehran wants sharply higher prices than Riyadh and has consistently pushed OPEC toward that goal. Tehran has not hesitated to use its military victories or its inherent strength as a regional power to intimidate other Gulf producers. [redacted]

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Near-Term Oil Market Situation

OPEC's Reversal of Oil Trends

OPEC's decision led by Saudi Arabia in late 1985 to capture a larger market share triggered a plunge in average world oil prices from $25 per barrel in January 1986 to about $11 by July 1986 (figure 3). The sharp drop in oil revenues and prospects of even lower prices prompted OPEC producers to reverse course in August and to adopt a production-sharing arrangement that caused prices to rise to about $14 per barrel by September. For 1986 as a whole, prices probably will average about $15 per barrel, compared with more than $27 in 1985. [redacted]

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A Higher Oil Price Case: Risks and Implications

A number of factors could push world oil prices above $20 per barrel as early as 1987. Although most forecasters expect prices to remain volatile within a range of $10-20 per barrel in 1985 dollars through 1990, these price expectations are based on a number of assumptions including, most important:

- *That Saudi Arabia supports a minimum price of $18 per barrel in 1987 and advocates stable prices around $18-20 per barrel through 1990.*
- *That there will be no clear victor in the Iran-Iraq war, or significant change in the relative military and political power of the two combatants.*

A major victory by Iran in its war with Iraq, however, could boost prices above $20 per barrel even without a supply disruption.[a] This could occur only with the compliance of Saudi Arabia, given its substantial capacity.

In our judgment, Saudi support for a $18-20 per barrel price encompasses a combination of factors including domestic economic pressure, short-term revenue requirements and long-term market concerns. For its part, Iran consistently has advocated $28 per barrel oil. Market analysts do not agree about the role, if any, Iran has played to date in the shift in Saudi policy toward support for higher, stable prices:

- *Some analysts believe that Saudi policy is driven by self-interest and that Fahd is not intimidated by Iranian threats.*

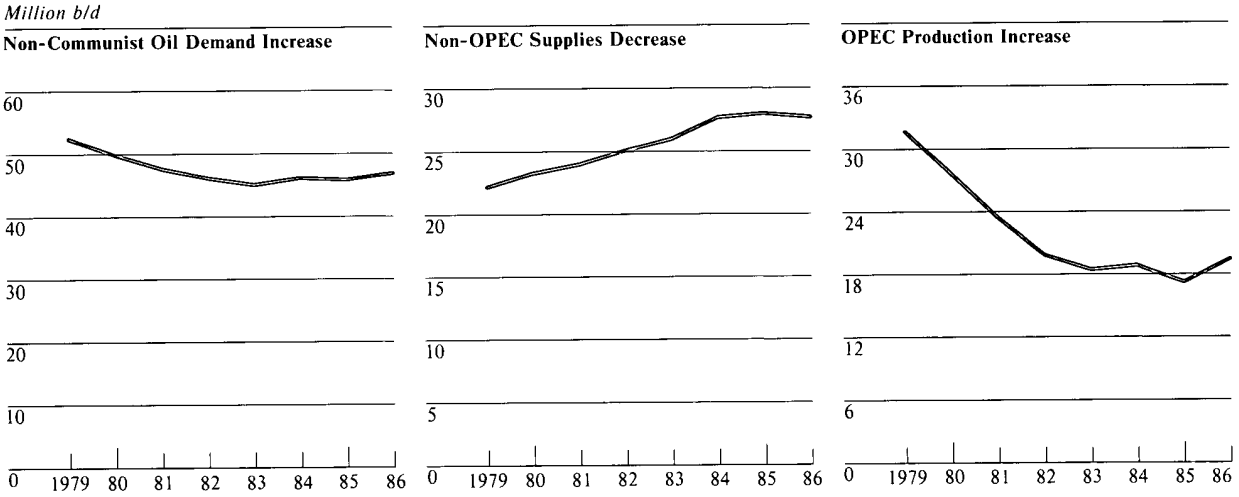
The medium-term outlook for oil prices probably depends both on whether there is a significant Iranian military success and on whether this, along with other concerns, alters Saudi support for prices in the $18-20 per barrel range.

We believe a reasonable scenario can be constructed in which a major victory by Iran in its war with Iraq, increased OPEC cohesion generated by recent success in reversing the price slide, and support for higher prices by an Iran-led coalition of poorer OPEC members combine to cause Saudi Arabia to permit a more rapid rise in oil prices than many forecasters now expect. This case would become increasingly likely should King Fahd focus attention on short-term economic factors, such as the expected continued drawdown of rapidly declining liquid internaitonal reserves. Market factors that would promote a faster rise in prices include a further erosion in the value of the US dollar and a resurgence in world inflation. *one measure that may provide an early indicator of Iranian success in intimidating Saudi Arabia is if the Kingdom, in contradiction of public statements, resumes the role of swing producer in OPEC.* 25X1 25X1 25X1

A much less likely—but possible—scenario is a full Iranian victory in the war that gives Iran effective control of oil production in Iraq and Kuwait. Under this case, to appease Iran, Saudi Arabia would yield to pressure for $28 per barrel oil as early as this year. Some knowledgable market analysts assert that oil prices could rise to $25-28 per barrel within 90 days if Iran wins a major victory. We judge Saudi Arabia would be unwilling to allow such a price rise given the risk of reversing fundamental supply and demand trends. 25X1

Higher world oil prices would have a number of immediate, negative economic consequences for the United states: a possible further deterioration in the US trade deficit, increased inflationary pressure, and slower economic growth. The size of these impacts would depend on how quickly and to what level prices rise as well as on the degree of price stability at the new level. Some offsetting benefits are possible with oil prices stable in the $22-25 per barrel range—increased US Government tax revenue from a reinstated windfall profits tax, regional and sectoral benefits, and promotion of long-run US energy security. These benefits, however, are less certain, less sizable, and less immediate. Moreover, such benefits would be quickly eroded if oil prices were not maintained at the higher level, leading instead to another boom-bust cycle in oil and energy markets. 25X6 25X1 25X1 25X1 25X1

Figure 4
Oil Trends, 1979-86



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The oil price collapse already has reversed several market trends (figure 4):

- Non-Communist oil consumption will increase in 1986 by about 1 million b/d to 47 million b/d, following a marked decline since 1979. Consumption in the United States, Japan, and Western Europe rose by about 2 percent from the 1985 level.
- Non-OPEC production declined slightly in 1986 for the first time since 1979. A number of producers encountered pricing and marketing problems during the height of the price war earlier in 1986 and were forced to cut production. In addition, some high-cost supplies—mostly in the United States—have been cut for economic reasons.
- OPEC producers increased output by over 2 million b/d to about 19.7 million b/d.
- OECD reliance on oil imports, particularly from the Middle East, will increase to about 17 million b/d in 1986, roughly one-half of total oil requirements (figure 5). US net imports will probably average nearly 5 million b/d in 1986, or about one-third of total oil requirements.

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A Volatile Oil Market to 1990

Most industry experts expect continued oil price volatility over the next several years with prices ranging between $10 and $20 per barrel.

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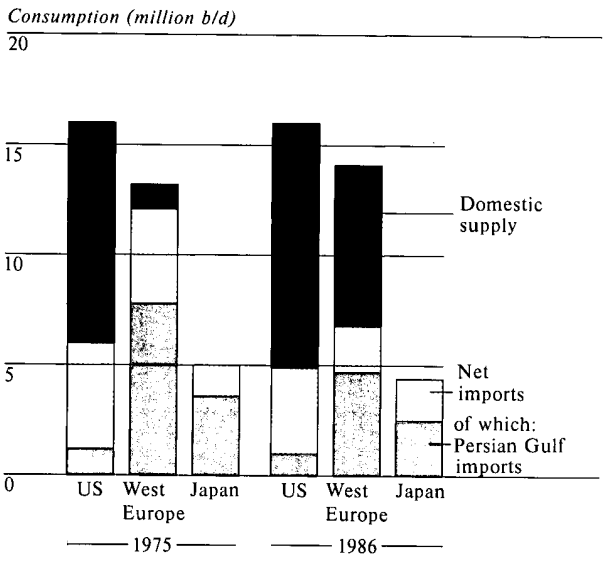
Demand Outlook. There is considerable uncertainty about the demand response to lower oil prices. On the basis of low price assumptions, many forecasters expect modest annual gains in oil consumption of less than 1 million b/d annually to a high of 51 million b/d by 1990. Some forecasters, however, believe

Figure 5
Import Dependence at a Glance, 1975 and 1986



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consumption may remain near current levels if prices rise, especially if economic growth in the industrial countries falters.

Supply Trends. The consensus among forecasters is that non-OPEC supply availability by 1990 will range from a low of about 26 million b/d to a high of 28 million b/d. Industry analysts believe that, as long as prices remain above $10 per barrel, the erosion of oil production for economic reasons is likely to be offset by new supplies coming on stream. Most operators can still cover their costs of production at prices above $10 per barrel and will continue to operate. Even when prices fall below marginal cost, some producers have been reluctant to cut production for several reasons: the irreversibility of some closures, the high costs of reopening wells, contractual commitments, or expectations that prices will rebound in the near future. Although production may trend downward in the United States and in other OECD producing countries, production increases—expected prior to the price plunge—in Colombia, Brazil, Syria, and Angola are likely to offset, at least partially, production declines elsewhere. Modest increases in oil demand and moderate declines in non-OPEC supply—at prices above $10—will cause world excess production capacity—currently about 10 million b/d—to decline to between 5 million and 9 million b/d in the near term. 25X1

OPEC Discipline Is Key

The burden of supporting prices will remain on OPEC during the next several years. If OPEC adheres to a production-sharing agreement, most forecasters expect oil prices to hover around $15 per barrel. Barring a major oil supply disruption, oil prices are not expected to rise much above $20 per barrel over the next several years. Saudi Arabia 25X1
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does not want prices to significantly rise above $20 per barrel before 1990 in order to keep 1986's oil market trends intact and to ensure a longer term market for its oil. It has enough excess production capacity to offset any movement in OPEC—led by Iran even if it wins the war with Iraq—to hold down production and raise prices substantially. 25X1
If OPEC producers fail to limit output and decide to increase production to the summer 1986 25X1
level of nearly 21 million b/d, another price war will ensue. Oil prices under these conditions, according to some industry projections, would fall below $10 per barrel, but market forces would probably prompt a rebound after a year or so. 25X1

Oil Market Outlook to 1995

Uncertainties regarding oil price paths, economic growth, producer behavior, the level of investment, and the response by consumers make it difficult to predict the medium-term oil market outlook. To assess possible outcomes, we reviewed 25X1
forecasts in an attempt to bracket possible outcomes. To summarize, we developed two scenarios, a more dependent case

Table 1
Non-Communist Oil Supply and Demand Projections

Million b/d
(except where noted)

	1975	1985	1990 Range		1995 Range	
			Less Dependent	More Dependent	Less Dependent	More Dependent
Demand	**45.1**	**46.4**	**48.0**	**51.0**	**49.0**	**53.0**
United States	16.3	15.7	15.9	17.2	16.3	17.8
Western Europe	13.1	11.7	12.2	12.8	12.0	13.1
Japan	5.0	4.3	4.5	4.7	4.4	4.8
Canada	1.8	1.5	1.5	1.7	1.6	1.8
Other OECD	0.6	1.1	1.1	1.1	1.0	1.1
LDCs	8.3	12.1	12.8	13.5	13.7	14.4
Supply	**44.9**	**46.2**	**48.0**	**51.0**	**49.0**	**53.0**
OECD	12.8	17.1	16.5	14.4	14.9	11.8
United States	10.0	10.6	9.7	8.8	8.7	6.8
Canada	1.7	1.8	1.8	1.4	2.0	1.3
Western Europe	0.6	4.0	4.3	3.5	3.5	3.0
Other OECD	0.5	0.7	0.7	0.7	0.7	0.7
Non-OPEC LDCs	3.0	8.6	9.6	8.5	10.7	8.5
Refinery gain	0.5	1.1	1.0	1.2	1.0	1.2
Net CPE exports	1.0	1.8	1.0	1.6	0.5	1.6
Non-OPEC	17.3	28.6	28.1	25.7	27.1	23.1
OPEC	27.6	17.6	19.9	25.3	21.9	29.9
Stock change	−0.2	−0.2				
US net oil imports	6.0	4.3	5.6	7.8	7.0	10.4
Dependence on Persian Gulf oil supplies *(percent of world supplies)*	41	24	28	35	32	41
Representative oil price path *(1985 $)*	21	27	20	15	30	20

Note: Ranges in consumption and production reflect different assumptions about economic growth, oil resource base, oil price trends, and other factors.

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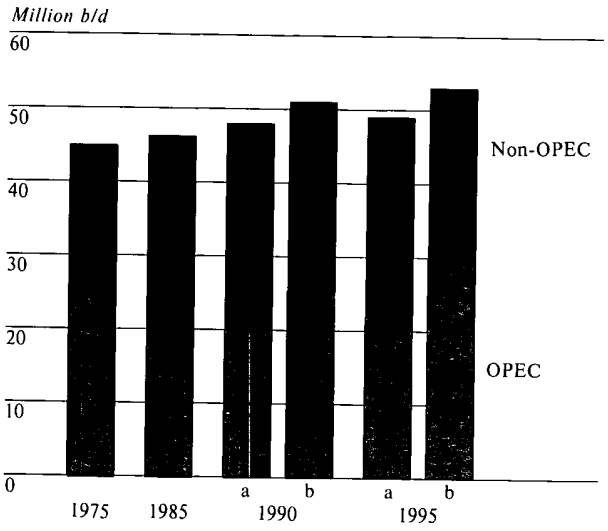
and a less dependent case (table 1). These cases reflect a variety of oil market uncertainties, in addition to oil prices:

- *The More Dependent Case.* Assumes a lower price path and a more conservative estimate of oil supplies independent of oil price trends. Average world oil prices are assumed to approximate $15 per barrel by 1990 and $20 by 1995. Other assumptions behind this scenario include the inability of producers to hold down output, about 3 percent economic growth in non-Communist nations, and lack of investment to develop new supplies.

Figure 6
Non-Communist Oil Supply Projections



[a] Less dependent.
[b] More dependent.

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- *The Less Dependent Case.* Assumes a higher price path and a higher oil supply estimate independent of oil price trends. Average world oil prices approximate $20 per barrel in 1990, increasing to roughly $30 by 1995. This scenario becomes more likely with OPEC production discipline and would be characterised by continued conservation and substitution away from oil, slower economic growth, and relatively stable levels of non-OPEC supplies.

Oil Demand Outlook

On the basis of industry projections, non-Communist oil consumption in 1995 is expected to range from 49 million b/d under the less dependent case to 53 million b/d under the more dependent case, an increase of nearly 3-7 million b/d from 1985 levels (figure 6). Most industry estimates expect oil consumption to rise more quickly during this decade than during the early 1990s, when rising real oil prices temper oil consumption growth.

The expected growth in oil consumption is divided fairly evenly among major products and regions. Middle distillate demand is expected to register the largest gain. Transportation fuels (motor gasoline and jet fuel) are projected to rise, with most of the gain expected in LDCs and the United States. Demand for remaining products, including residual fuel oil, is expected to rise fairly evenly among the major regions.

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Under both scenarios, growth in energy demand is less than GNP growth, suggesting that energy efficiency gains achieved in the 1970s and early 1980s will continue, albeit at a declining rate. Oil consumption is assumed to grow more slowly than total energy consumption under both cases, implying substitution of other forms of energy for oil.

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These assumptions are based on a number of factors:

- Investment in new fuel substitution capability and energy-saving plant and equipment now under construction is unlikely to be canceled.

- Technologies developed during the past 10 years to reduce oil consumption will continue and new research and development will remain strong as long as higher future prices are expected.

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- Although the prices of competing fuels are only slowly adjusting to the sharp declines in oil prices, prices for natural gas and coal will probably remain competitive with oil. Most European and Japanese gas prices are tied to petroleum product and crude oil prices with a lag. Gas prices in North America have been falling over the past several years.

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OECD Consumption. Oil consumption in the OECD countries is projected to rise by slightly more than 4.4 million b/d between 1985 and 1995. Under the less dependent case most of the increase is expected to occur in the United States:

- *US* oil consumption is projected to range between 16 and 18 million b/d in 1995.

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- *West European* oil use in 1995 is expected to range between 12 and 13, compared with nearly 12 million b/d in 1985.
- Little growth is expected in *Japanese* oil use under the less dependent case. Consumption could approach 5 million b/d in 1995 under the more dependent case.

LDC Consumption. In both scenarios, growth in LDC oil consumption will be more robust than OECD growth. LDC oil demand in 1995 is projected to increase to slightly more than 2 million b/d from 1985 levels under the low and high price cases, respectively. Population growth in the LDCs is expected to fuel more rapid economic expansion, especially in energy intensive industries. Lack of infrastructure and funds to support investment in alternative energy sources will constrain oil substitution efforts.

Supply Outlook

Although the resource base is ample, translating reserves into production potential will be the key to determining future oil supply availability. Proved world oil reserves approximate 690 billion barrels—equal to about 30 years of supply at current consumption rates. Almost 60 percent of total reserves, however, are concentrated in the Middle East region. Development of supply capacity depends largely on investment decisions heavily influenced by expectations of future demand levels, prices, the availability of funds, and advancements in technology.

Non-OPEC Supplies. Although projections vary widely, most forecasters expect total non-OPEC supplies, including net Communist exports, to decline by 1995 (table 2). Under the more dependent case, low prices dampen investment and cause non-OPEC supply to fall toward 23 million b/d, some 5 million b/d below current levels. In the less dependent case, non-OPEC supplies hold fairly steady through 1990 and then gradually decline to roughly 27 million b/d by 1995. In either case, most of the reduction in output is expected in the high-cost areas, such as the United States.

OECD oil supplies are likely to decline by 1995 through a combination of declining output from existing fields and sluggish exploration and development efforts. Forecasters estimate total OECD production to be between 11.8 million b/d under the more dependent scenario and 14.9 million b/d under a low dependent scenario, a drop of as much as 5 million b/d from current levels. This wide range in projected production results from different estimates about the oil resource base, decline rates from existing fields, and oil price trends. Production from proved reserves in most OECD countries will be costly because many require investment in secondary and tertiary recovery. New finds will most likely be in high-cost frontier or offshore areas. Environmental regulations have driven up costs in many of these areas. 25X1

Low oil prices already have caused a sharp cutback in oil company exploration and development expenditures, with most firms focusing their scaled-down efforts in areas outside the United States and other high-cost OECD countries. Declining production costs are not expected to compensate for low oil prices. For example, drilling activity in Western Europe declined by more than 30 percent in 1986, and, once rig contract and license obligations expire, activity is expected to decline further. Although lower activity is unlikely to influence production in the near term, long-term supplies will suffer unless investment trends are reversed:

- *US* production capacity is expected to range between 6.8 and 8.7 million b/d in 1995—a decline of 1.9-3.8 million b/d from 1985 levels (figure 7). The diminishing resource base, continuing decline in drilling activity, and the shutting in of some stripper well capacity will reduce US output.

- Estimates of *North Sea* production range from 3.0 million b/d to 3.5 million b/d. Substantial additional production from Norway through the early 1990s and small gains in the Netherlands and Denmark are not expected to offset the decline in UK output through 1995. Forecasters disagree on the pace of an output decline. Some argue that a steep cut in upstream investment combined with depletion of maturing fields will drive down output quickly. even if

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Table 2
Non-OPEC: Available Production Capacity

Million b/d

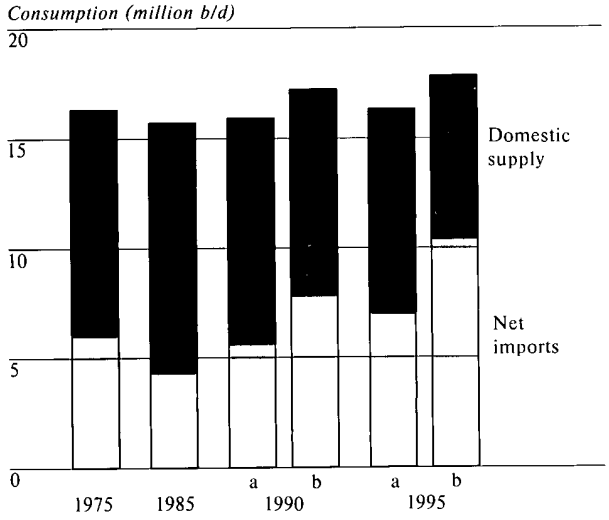
	1975	1985	1990	1995
Non-OPEC total	**17.3**	**28.6**	**25.7-28.1**	**23.1-27.1**
OECD	12.8	17.1	14.4-16.5	11.8-14.9
Of which:				
United States	10.0	10.6	8.8-9.7	6.8-8.7
Canada	1.7	1.8	1.4-1.8	1.3-2.0
Norway	0.2	0.9	1.3-1.5	1.3-1.4
United Kingdom		2.7	1.8-2.4	1.3-1.7
Other Western Europe	0.4	0.4	0.4	0.4
Other OECD	0.5	0.7	0.7	0.7
Non-OPEC LDCs	3.0	8.6	8.5-9.6	8.5-10.7
Of which:				
Mexico	0.8	3.0	2.6-3.3	2.6-2.8
Egypt	0.2	0.9	0.9	0.8-1.0
Malaysia	0.2	0.5	0.4	0.4-0.5
Brazil	0.2	0.6	0.8-0.9	0.8-1.0
Angola	0.2	0.3	0.4	0.4-0.5
Cameroon		0.2	0.1	0.1
North Yemen			0.2-0.4	0.5
India	0.2	0.6	0.5-0.6	0.3-0.5
Brunei	0.2	0.2	0.2	0.2
Colombia	0.2	0.3	0.4	0.4
Oman	0.3	0.5	0.5	0.5-0.7
Other	0.5	1.5	1.5	1.5-2.5
Net CPE exports	1.0	1.8	1.6-1.0	1.6-0.5
Refinery gain	0.5	1.1	1.2-1.0	1.2-1.0

25X1

oil prices return to $20 per barrel, most oil companies will not return to frontier exploration. Other experts see improved technology and increased efficiency keeping small fields viable and improving the development potential of new reserves. According to one industry expert, operators will use existing technology to bring small fields on stream at a low cost. For example, small offshore fields could be tied to large existing platforms with substantial excess capacity.

- Estimates of 1995 *Canadian* production range from 1.3 to 2.0 million barrels per day. Production is expected to peak within the next few years, decline slowly, then rebound if frontier areas are developed and high-cost synthetic crudes are produced. Dismantlement of the National Energy Program and the phasing out of many of its taxes led to record exploration efforts in 1985. This has provided some cushion against falling prices. In late 1986, however,

Figure 7
US Oil Projections



[a] Less dependent.
[b] More dependent.

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nearly all frontier exploration was put on hold because of low prices, despite promising finds and continuing success in locating oil. The timing of a production rebound depends on how quickly activities resume in the frontier and syncrude arenas.

Net Communist exports are also projected to decline by 1995. Although estimates vary, experts estimate that net exports could drop from 1.8 million b/d in 1985 to between 0.5 and 1.6 million b/d:

- The natural aging and depletion of existing oilfields in the *USSR*—exacerbated by continuing overproduction—is expected to constrain Soviet oil production over the medium term. If production in the USSR begins to fall rapidly, as some forecasters project, the Soviets would probably make cuts in oil exports to the West, but exports to Eastern Europe could also drop off.

- Despite the recent strong performance in *China*'s energy sector, increased investment and greater foreign participation probably are needed to keep China's production capacity from falling over the course of the decade. Experts expect that lower oil prices may cause foreign oil firms to reduce their exploration efforts in China. Exports to the West could fall over the next decade. 25X1

Industry estimates indicate *non-OPEC LDC* oil production could range between 8.5 million b/d to about 10.7 million b/d, compared with current production of 8.6 million b/d. Recent cutbacks in exploration and development efforts have not affected the LDCs as seriously as the developed countries, and most analysts believe that the LDCs have significant additional production potential. In addition, a number of small LDCs are considering sweetening their investment climates in the hope of stimulating investment. To date, however, these actions have brought only lukewarm response from oil companies. 25X1

Over the 1990 to 1995 period, many analysts expect production in *Brazil* to rise substantially because of continued high priority placed on energy investment. Smaller increases are expected in *Angola* and *Colombia*. A major find in *North Yemen* this year—if 25X1
exploited—could add from 200,000 and 400,000 b/d to non-OPEC LDC capacity by 1995. 25X1

Mexico is the wild card among non-OPEC LDCs. Industry estimates suggest that Mexican oil output could either rise or fall from the current level of 2.8 million b/d. Financing problems, the poor quality of unexploited reserves, and limited geological prospects 25X1
will restrict Mexico's ambitious development plans. More important, the sharp drop in reservoir pressure in the Abkatun and Cantarell fields in the Bay of Campeche—Mexico's largest producing region—in 1986, as a result of rapid depletion rates, could hurt production capacity well into the next decade.

OPEC Supply Availability. Lower oil prices and 25X1
revenues and lower projections of oil demand have also reduced spending for development and maintenance of production capacity in many OPEC countries. As a result, available capacity in several OPEC states is likely to erode over the near term (table 3 and figure 8). Anticipated gains in capacity from Iran and

Table 3
OPEC: Available Production Capacity [a]

Million b/d

	1975	1985	1990	1995
Total OPEC	**33.7**	**27.8**	**28.9-30.4**	**29.6-33.1**
Persian Gulf	23.0	18.8	20.2-21.7	21.3-24.8
Of which:				
Saudi Arabia	8.6	8.5	9.0-9.5	9.0-10.5
Iran	6.5	3.4	3.5-4.0	4.0-5.0
Iraq	2.5	2.0	2.5-3.0	3.0-4.0
Kuwait	2.1	2.0	2.0	2.0
UAE	2.1	1.7	2.0	2.4
Qatar	0.6	0.6	0.6	0.5
Neutral Zone	0.6	0.6	0.6	0.4
Non Persian Gulf	10.7	9.0	8.7	8.3
Of which:				
Algeria	1.3	1.1	0.8	0.7
Ecuador	0.3	0.3	0.3	0.2
Gabon	0.2	0.2	0.2	0.1
Indonesia	1.5	1.5	1.5	1.4
Libya	2.3	1.6	1.8	2.0
Nigeria	2.3	1.8	1.8	1.7
Venezuela	2.8	2.5	2.3	2.2

[a] Includes natural gas liquids.

25X1

Iraq in a postwar environment, however, should more than offset these small losses. As a result, estimates of OPEC's available capacity range between 30 million b/d and 33 million b/d by 1995.[1] At the high level, OPEC capacity would rise by 5 million b/d above current levels and approximate peak levels achieved in 1977.

25X1

In the *Persian Gulf* region, an end to the Iran-Iraq war before 1995 is likely to cause both countries to raise capacity to rebuild their economies. Within a few years, Iran and Iraq combined could raise capacity to near prewar levels of about 8 million b/d. *Iraq*'s available capacity is currently limited by the capacity of its export lines through Turkey and Saudi Arabia, but plans to expand these lines will eliminate export constraints by 1990. Baghdad's oilfields are currently capable of producing between 3 and 4 million b/d. Other oilfield development figures prominently in the new five-year plan. In particular, attention will be focused on the East Baghdad field, which will come on stream in 1988 and could reach an output level of 200,000 b/d by 1991.

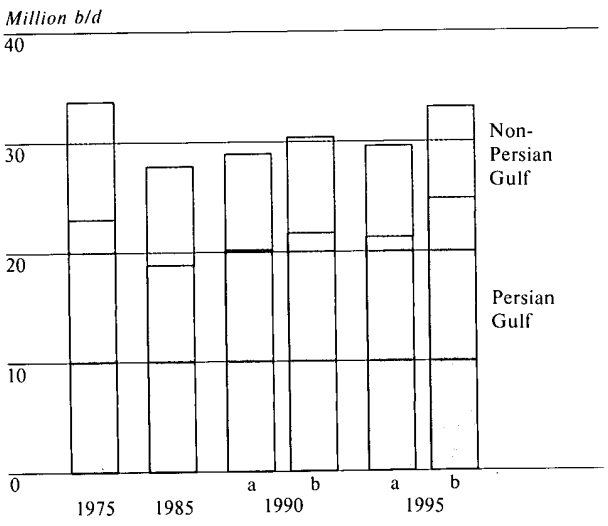
25X1

In *Iran*, an ambitious gas injection program for onshore fields instituted in 1986 could raise oil productive capacity to as much as 5 million b/d by the mid-1990s. Tehran spends about $500 million annually on field maintenance, but Iran still needs to

[1] Available capacity is the level of supply than can be brought on stream within 30 to 90 days.

25X1

Figure 8
OPEC: Available Productive Capacity



[a] Less dependent.
[b] More dependent.

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improve the conditions of its surface facilities to make better use of these outlays. Iranian concern about its surface facilities prompted Tehran last year to consider reopening US offices in order to facilitate acquisition of oilfield maintenance and services equipment. Additions to capacity beyond 1990 will probably center on secondary recovery to increase flow rates in both onshore and offshore wells. Tehran may also try to develop offshore potential in the Caspian Sea.

In *Saudi Arabia,* low oil demand and prices, coupled with efforts to conserve the Kingdom's chief resource, have led to the mothballing of production facilities and a decline in Riyadh's operating capacity. Since 1982, Saudi Arabia's level of available capacity has dropped from 10 million b/d to about 8.5 million b/d. About 7 million b/d could be produced on an immediate basis.

25X1

On the basis of the present Saudi objective to maintain prices low enough to ensure a long-term market for Saudi oil, we believe Riyadh might increase capacity to about 10.5 million b/d by 1995 if it were needed to counter demand pressures for higher prices.

Kuwait has reduced expenditures for adding to production capacity for the same reasons as the Saudis. Damage in 1986 to Kuwait's central mixing manifold, which blends crude from a number of central and southern fields and distributes it to tank farms, has temporarily reduced available capacity from nearly 2 million b/d to 1.6 million b/d. The Kuwaitis are apparently convinced that they will not need additional capacity and have delayed plans to repair the manifold until the spring of 1987, according to the US Embassy. By 1990, however, Kuwait will have restored available capacity to the 2-million-b/d level, and we expect capacity to remain at this level in the early 1990s.

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The *United Arab Emirates* has set a capacity target of 2 million b/d by 1990. We expect further expansion through 1995, but, because of its past conservative approach to building its available capacity, the level probably will not exceed 2.4 million b/d. The UAE currently has ceilings on individual field production in response to recommendations from an extensive engineering study commissioned in the late 1970s. Most additional capacity will be developed offshore; Abu Dhabi plans to shift the bulk of its expenditures for onshore production—about $200-300 million—from further development work to well maintenance. *Qatar* has huge potential offshore gas resources, but no plans to market the gas. Oil production capacity will remain fairly constant because of a limited resource base.

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The outlook for supply availability from OPEC countries outside the Persian Gulf is for a decline to about 8.3 million b/d, a fall of less than 1 million b/d by 1995. Financial constraints from the weak oil market

25X1

and low prices and declining output from mature fields are the primary reason for the expected small declines in output from most non-Gulf OPEC countries.

Venezuela's national oil company's investment program through 1992 calls for spending about $400 million on all phases of oil, gas, petrochemical, and coal production. Only a modest increase is devoted to maintenance of production capacity levels. Venezuela recently discovered a new field containing 1 billion barrels of oil, but current disincentives to investment mean that replacement capacity in the years ahead will come from improved recovery methods at currently producing basins. This could erode Venezuela's production capacity by 300,000 b/d—or to 2.2 million b/d—by 1995.

Nigeria and *Indonesia* face smaller erosions to available capacity. Nigeria's available production capacity has declined in recent years to 1.8 million b/d and will continue to erode slightly, mainly because of disappointing results from recent drilling efforts, the lack of a much-needed gas injection program to maintain reservoir pressures, and cash-flow problems. Efforts to improve future production potential will emphasize well workovers rather than new development, and Nigeria's production capability will drop to 1.7 million b/d by 1995. *Indonesia* may also experience a dropoff in production capacity by 1990, mainly because of a decline in output from existing mature oilfields. One major oil company operating in Indonesia claims that Jakarta needs to improve the investment climate to avert a continued decline in Indonesia's capacity to 1.3 million b/d by 1995.

Other OPEC countries outside the Persian Gulf area—*Algeria*, *Ecuador*, and *Gabon*—are relatively small producers and are largely resource constrained from developing higher capacity. Algeria's capacity has been in decline in recent years because of the maturity of its fields. Algiers has also redirected national priorities to gas development and suffers from high drilling costs and other operating bottlenecks that limit drilling activity, according to the US Embassy in Algiers. In contrast, *Libya*—of all the OPEC countries outside the Persian Gulf region—has the potential for growth. Even though available production capacity has fallen to 1.6 million in recent years, well workovers, additional drilling, and modifications to existing pumping and pipelines systems could restore and even increase capacity to about 2 million b/d by 1995. Over the near term, financial constraints and the withdrawal of US companies will continue to limit Tripoli's capacity development.

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Demand for OPEC Oil: Implications for Energy Security

Given the estimates of consumption and non-OPEC supply, demand for OPEC oil by 1995 is expected to range from 22 million b/d under the less dependent case to 30 million b/d under the more dependent case. Although capacity will be ample to cover the range of projected demand, the availability of surplus capacity will erode over the decade. Under these circumstances, non-Communist surplus capacity would fall from approximately 10 million b/d in 1985 to 7.7 million b/d under the less dependent case, and to 3.2 million b/d under a more dependent case.

25X1

25X1

Uncertainties

In addition to the possibility of supply disruptions, there is a substantial risk that current forecasts will fail to accurately gauge long-term trends in key economic variables and their impact on energy markets (table 4). Relatively small changes in key variables—such as economic growth, price trends, and the responsiveness of supply and demand to changes in energy prices—compounded over time can considerably alter long-term supply and demand balances. In addition, several other uncertainties exist:

25X1

- There may be a tendency among forecasters to miscalculate future energy requirements because we have no empirical evidence from past trends to suggest how the market will react to a drastic fall in prices.

- The position of the business cycle will also cause differences in oil requirements during our projection period. For example, while non-Communist economic growth may in fact increase at an average annual

Table 4
Key Variables and Underlying Assumptions

	Less Dependent		More Dependent		Remarks
	1990	1995	1990	1995	
Demand *(million b/d)*	**48.0**	**49.0**	**51.0**	**53.0**	The more dependent case assumes a low price path—$15 per barrel in 1990 (1985 dollars) and $20 per barrel by 1995—and an economic growth rate of 3 percent annually. The less dependent case assumes a higher price path—$20 per barrel (1985 dollars) in 1990, $30 by 1995—and slightly lower economic growth.
OECD	35.1	35.3	37.5	38.6	Higher OECD demand reflects large increases in the United States.
United States	15.9	16.3	17.2	17.8	US consumption is expected to grow.
LDCs	12.8	13.7	13.5	14.4	LDC consumption is more robust than OECD's, reflecting higher demand in oil-producing LDCs.
Supply [a] *(million b/d)*	**48.0**	**49.0**	**51.0**	**53.0**	Supply outlook under both cases is contingent upon investment decisions, prices, availability of funds, and technological advances.
OECD	16.5	14.9	14.4	11.8	Decline in OECD supplies reflects declining output in the United States and the United Kingdom.
United States	9.7	8.7	8.8	6.8	Assumes 2- to 4-million-b/d drop in US production by 1995 because of diminishing resource base, drilling activity, and the shutting in of stripper wells.
North Sea	3.9	3.1	3.1	2.6	Decline in UK output; more than offsets higher Norwegian production.
Non-OPEC LDCs	9.6	10.7	8.5	8.5	Higher production in Brazil, Angola, and Colombia. Mexico is the biggest wild card among forecasts.
OPEC capacity	28.9	29.6	30.4	33.1	Increase in OPEC supply assumes an end to Iran-Iraq war. Saudi Arabia is expected to maintain flexibility to increase production to as high as 11 million b/d to keep market stable.
Other	2.0	1.5	2.8	2.8	
Excess productive capacity *(million b/d)*	**9.0**	**7.7**	**5.1**	**3.2**	Surplus capacity is expected to erode because of increased demand and the lack of additions to capacity worldwide. Concentration increasingly in Persian Gulf area.
US import dependence *(million b/d)*	**5.6**	**7.0**	**7.8**	**10.4**	Higher imports reflect lower output and growing demand.
Disruptions					
Moderate (gross supply loss)	**5.0**	**5.0**	**5.0**	**5.0**	Moderate disruption entails gross supply loss for six months, possibly caused by disruption in Iranian, Iraqi, Kuwaiti, or Saudi production; political change in Saudi Arabia; or a combination. A moderate disruption case approximates some past disruptions.

Table 4
Key Variables and Underlying Assumptions (continued)

	Less Dependent		More Dependent		Remarks
	1990	1995	1990	1995	
Major (gross supply loss)	**14.0**	**14.0**	**14.0**	**14.0**	Major disruption assumes wide Persian Gulf war that cripples export facilities and interdicts virtually all supplies from the area for six months. More severe than experiences to date.
Net supply surplus (shortfall)					
Moderate *(5-million-b/d loss)*	**4.0**	**2.7**	**0.1**	**(1.8)**	Surplus capacity provides considerable cushion against moderate disruptions for the remainder of the decade. In the more dependent case, nearly a 2-million-b/d net shortfall would occur in 1995, comparable to shortfalls since 1970 that caused major upheaval.
Major *(14-million-b/d loss)*	**(5.0)**	**(6.3)**	**(8.9)**	**(10.8)**	Major disruptions in 1990 and 1995 cause severe net supply shortfalls. Availability of surplus capacity plays more pivotal role. A major disruption would cause nearly double the shortfall under the more dependent case than under the less dependent case.
Pipeline capacity outside Strait of Hormuz *(million b/d)*	**6.3**	**6.3**	**6.3**	**6.3**	Serves as a major offset to the impact of a supply disruption in the Middle East. Assumes expansion of Saudi Arabia's East-West pipeline not completed before 1995; pumping modifications to the East-West pipeline could cause pipeline capacity outside the Strait of Hormuz to rise to more than 8 million b/d.

[a] We assume non-OPEC production is equal to capacity.

25X1

rate of 3 percent, year-to-year variations may not be smooth. Energy demand is quite sensitive to changes in economic growth; therefore, replicating wide variations in year-to-year growth through our projection period—instead of using a smooth 3-percent growth rate—could alter projections of demand by several million b/d.

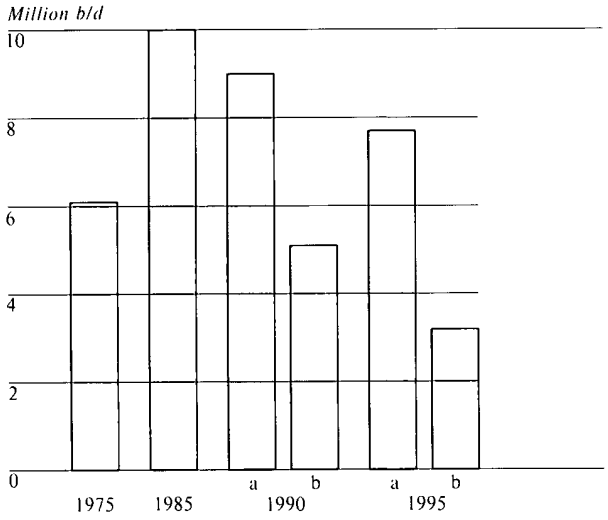
- On the supply side, while we believe it to be less likely, there is the possibility of further huge oil discoveries, particularly in the largely unexplored offshore regions. There is also a good possibility that technological advances in oilfield technology, making oil production profitable at lower prices, will limit any decline—or could even encourage growth—in non-OPEC production capacity. For example, some industry analysts recently indicated that improvements currently being researched in exploration and production technology could reduce costs by up to one-third—and in some cases by 50 percent—in the next 10 years.

25X1

Oil Supply Disruptions

The present cushion of surplus capacity will provide considerable protection against all but a major disruption for the remainder of the decade, but by the mid-1990s the impact of even a moderate disruption could be severe (figure 9). Because surplus capacity will become increasingly concentrated in the Persian Gulf area, less supplies will be available elsewhere to help offset an interruption of supply from this region. Even if the United States maintains a relatively low level of

Figure 9
Erosion of the Surplus Production Capacity Cushion



[a] Less dependent.
[b] More dependent.

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imports and a diversity of suppliers, the high import dependence of other major consumers will make the US market susceptible to the price impact and other effects of a disruption.

Types and Causes of Disruptions

Energy supply disruptions have occurred frequently in the past, and the probability that disruptions will occur in the future is quite high. Technical and accidental supply disruptions, such as pipeline leaks or fires, are generally limited in duration, severity, and impact. Deliberate supply disruptions resulting from political, military, or other disputes—such as disagreements on price—are more serious. Three disruptions since 1970 have had significant impacts on the market:

- Libya's move to reduce foreign company production in 1970, coupled with pipeline sabotage in Syria, caused a 25-percent rise in oil prices.
- The 1973-74 Arab oil embargo and production cutback contributed to a quadrupling of crude prices and a sharp drop in worldwide GNP growth.
- The Iranian revolution precipitated supply losses that led to a near tripling of oil prices between the spring of 1979 and 1981. 25X1

The concentration of production capacity in the Persian Gulf naturally draws attention to this region as a potential source of serious disruptions, and repeated threats of an escalation in the Iran-Iraq war continue to raise concern about the risk of a major supply cutoff. The region contains numerous production and export facilities susceptible to damage from war or sabotage, and events during the Iran-Iraq war illustrate the vulnerability of these facilities. Other diverse considerations, such as the need for exported oil to pass through the Strait of Hormuz, Red Sea ports, or countries on the Mediterranean, the hostile policies of Arab Persian Gulf countries toward Israel, and interdependence between Saudi stability and the fortunes of the House of Saud contribute to longer term concerns. 25X1

Persian Gulf Prospects

Almost all countries of the Persian Gulf region will be vulnerable to some form of internal political unrest in the 1990s. Besides the Iran-Iraq war, economic problems, political disaffection, Islamic fundamentalism, and terrorism pose the greatest threats to political stability in the region: 25X1

- Iran, Iraq, and Bahrain are most vulnerable to political upheaval and might experience episodic instability during the 1990s. 25X1

- Saudi Arabia, Kuwait, and the United Arab Emirates are likely to face increased popular malaise, but the current regimes probably will be able to maintain political power. Nonetheless, domestic problems might prompt shifts within the leadership of these states. 25X1

Internal political instability probably would not threaten Persian Gulf oil exports, although terrorist or subversive attacks might temporarily disrupt production and export operations. Nevertheless:

- Radical regimes might try to restrict exports to the West and the United States if they were confident they could find enough reliable consumers in the non-Western world.

Table 5
Oil Disruptions—Summary

Million b/d

	Moderate Disruption				Major Disruption			
	1990		1995		1990		1995	
	Less Dependent	More Dependent	Less Dependent	More Dependent	Less Dependent	More Dependent	Less Dependent	More Dependent
Gross disruption	5	5	5	5	14	14	14	14
Excess capacity available	9.0	5.1	7.7	3.2	9.0	5.1	7.7	3.2
Net supply disruption surplus/shortfall	4.0	0.1	2.7	−1.8	−5.0	−8.9	−6.3	−10.8

25X1

- The emergence of fundamentalist or extremely reactionary regimes that deemphasized economic development might lead to significant cutbacks in oil production.
- Instability in moderate states might induce some regimes to reduce the visibility of their ties to the West.

25X1

Regional conflicts probably will pose the greatest threat to the flow of oil in the 1990s:

- Traditional regional rivalries among Iran, Iraq, and Saudi Arabia are likely to continue in the 1990s and might lead to the destruction of some oil production and export facilities.
- The regional ambitions of some countries might lead to military exploits against smaller oil exporters.
- A serious outbreak of Arab-Israeli fighting might lead to a temporary embargo of oil exports to the West in an attempt to intimidate Israel's supporters.
- Local conflicts and instability have served as principal avenues for the expansion of Soviet influence in the Near East. The USSR, for example, will try to gain influence in any post-Khomeini regime in Iran. While the prospects for major Soviet political inroads in the region are not great in the near term, Western energy security would be seriously threatened if the Persian Gulf's vast oil resources came under increased Soviet influence.

25X1

Disruption Cases

To examine the potential impact of a supply disruption, we analyzed two possible situations in 1995 under both the more dependent and less dependent cases (table 5):

- A moderate case in which 5 million b/d of production capacity is lost for six months. Among the wide range of possibilities that could contribute to such a loss are a partial disruption of Iranian, Iraqi, and possibly Kuwaiti production; political change in Saudi Arabia; increased Iranian influence over Gulf supplies; or some combination of political or military disputes involving key oil producers.
- A major disruption case involving a loss of about 14 million b/d in production capacity for six months caused, for example, by a wider Persian Gulf war that cripples Gulf export facilities, restricts tanker traffic and Saudi East-West pipeline shipments, and interrupts oil exports through the Iraq-Turkey pipeline; by widespread political upheaval and strife fomented by Iranian success in exporting the Islamic revolution; or by a concerted effort by Gulf states to exert political pressure on the West to alter policies toward Israel.

The major disruption case is considerably more severe than any experienced to date, but it illustrates the potential consequences of Western dependence on Persian Gulf oil supplies (figure 10). The moderate

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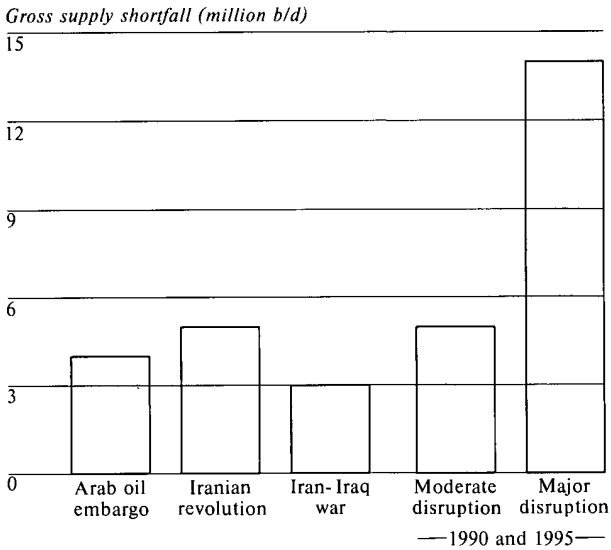
Figure 10
Disruption Scenarios: A Comparison



case, on the other hand, approximates some past disruptions and has a much higher probability of occurrence.

Market Impact

In case of a disruption, a number of factors besides the volume of supplies affected and the length of the disruption will determine its severity. The impact on the United States and other major consuming countries will be largely determined by the market backdrop—particularly the availability of surplus energy production capacity. Other factors, such as the policy responses of producer and consuming countries, position in the business cycle, the strength of oil consumption growth, and market expectations and uncertainties will also be critical. These will outweigh US oil import dependence, which is but one indicator of energy vulnerability and not a particularly accurate one. For a major consumer such as the United States, even a low level of imports will make the domestic market susceptible to oil price shocks.

The potential for producing countries to reduce the impact of a disruption will be determined mainly by:

- The availability of surplus oil production capacity to help offset the shortfall.
- The capability to divert supplies through alternative export routes, such as the major Persian Gulf oil pipelines.

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The consuming countries' response will be largely defined by:

- The availability of stocks, particularly government-held inventories.
- Capabilities to reallocate supplies, including the flexibilities of refining systems to handle diverted supplies.
- Demand restraint measures.
- Potential for interfuel substitution and the availability of alternative fuels.

25X1

Producer Response

Surplus oil production capacity is probably the most important protection against a severe supply disruption. In general, most excess capacity probably would be available because producers would be interested either in higher revenues or in helping to stabilize the market, or both. With the exception of Saudi Arabia, however, producers do not generally pursue policies of maintaining a large reserve of excess capacity. The current excess capacity of nearly 10 million b/d results from the plunge in demand for OPEC crude from more than 30 million b/d to less than 20 million b/d since 1979. The Saudis maintain surplus capacity to influence prices, but other producers seek to produce at or near capacity levels on a regular basis and are highly unlikely to rebuild surplus capacity once it erodes.

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Persian Gulf oil export pipelines that bypass the Strait of Hormuz offer additional potential from producers to help offset a supply disruption. These pipeline projects received a strong impetus from the Iran-Iraq war, and are being built expressly to avoid the physical dangers and limitations of exporting oil from the Gulf. The current 2.9-million-b/d capacity of export pipelines around the Strait will increase to 6.3

25X1

Middle East Pipeline Outlook

The Iran-Iraq war has led Persian Gulf countries to build more flexible oil export systems bypassing the Strait of Hormuz (figure 11). The current 2.9-million-b/d capacity of oil export pipelines around the Strait will increase to 6.3 million b/d by 1990 with the completion of projects to expand the Iraq-Turkey, Iraq-Saudi, and Petroline pipelines (table 6). In addition, pumping modifications to the expanded Petroline could increase Saudi Red Sea export capacity by about 2 million b/d and raise the region's capacity to circumvent the Strait of Hormuz to more than 8 million b/d.

Existing Export Alternatives. *Only two large-diameter pipelines currently provide alternative oil export routes around the Strait of Hormuz:*

- *The Iraq-Turkey line will expand to 1.5 million b/d by mid-1987.*
- *The Saudi Petroline will expand to 3.2 million b/d by spring 1987.*

By 1990 these projects, combined with the planned expansion of the 1.6-million-b/d Iraq-Saudi pipeline system connecting Baghdad's southern oilfields to the Red Sea, will raise the total throughput capacity to about 6.3 million b/d. Two other oil export pipelines bypassing the Strait—Tapline and the Iraq-Syria-Lebanon pipelines—remain closed in part because of the deteriorating equipment.

Viable Alternatives for Raising Bypass Export Capacity. *Oil exports circumventing the Strait of Hormuz could be increased another 25 percent by increasing the pumping capacity of the Saudi Petroline. The line's capacity could be raised by almost 2 million b/d to more than 5 million b/d by adding two additional pumps—one for operation and one for standby. The additional capacity would raise alternative Red Sea oil export capacity to about 6.6 million b/d with the completion of the Iraq-Saudi pipeline system. Including Turkish exports from Iraq, alternative oil flow would then exceed 8 million b/d.*

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Other Proposals. *Several other pipeline proposals to the Strait of Hormuz are under consideration:*

- *Kuwait plans to build a pipeline of at least 500,000-b/d capacity by late 1987 that will connect its oilfields with the Saudi East-West line at pumpstation 3. Although the pipeline will enable Kuwaiti exports to bypass the Persian Gulf, it will not increase the total amount of exports available at the Red Sea terminal of Yanbu al Bahr.*

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- *A Jordanian plan to refurbish the 500,000-b/d capacity tapline and extend it from Aq Zarqa to Amman's Red Sea port of Al Aqabah. The outlook for this project is doubtful given the lack of Saudi support.*

- *Iranian plans for a 2-million-b/d pipeline system from Gachsaran oilfield to Bandar Beheshti on the Indian Ocean. This project is unlikely, at least until the war is over, given Iraq's capability of conducting accurate long-distance airstrikes. Economic and political factors make the construction of a proposed Iran-Turkey crude line from Ahvaz to a Turkish port on the Mediterranean or the Black Sea unlikely at this time.*

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- *Various proposals for Gulf Cooperation Council export lines—a 2-million-b/d line to Al Fujayrah or a 1-million-b/d line to Ash Shariqah—have been discussed. An 800,000-b/d line inside the United Arab Emirates from Abu Dhabi to Al Fujayrah has also been proposed. These projects, however, are unlikely to be built unless technical and economic problems are overcome.*

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Figure 11
Proposed Oil Pipelines in the Middle East

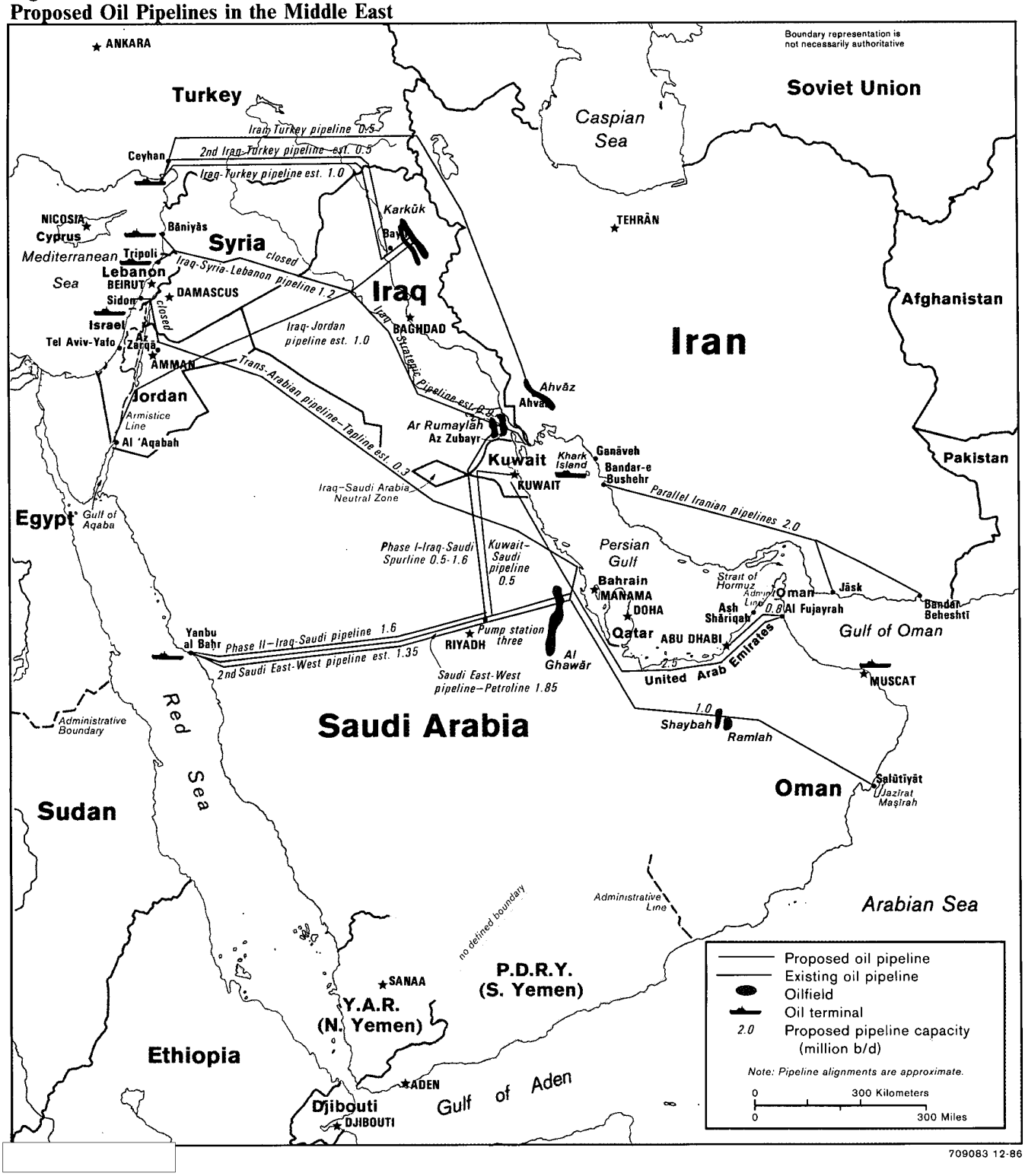

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Table 6
Persian Gulf Oil Export Pipelines

	Diameter (*inches*)	Nominal Capacity (*MMBD*)	1986 Capacity	1990 Capacity	1995 Capacity	Remarks
Potential throughput				6.8	6.8-14.4	
Existing						
Total		6.2	2.9	6.3	6.3-8.1	
Saudi Petroline	48/56	1.9	1.9	3.2	3.2-5.0	Two pumps per station needed to raise extra 1.8 MMBD in 1995.
Iraq-Turkey	40/46	1.0	1.0	1.5	1.5	
Iraq-Syria-Lebanon [a]	12/16/30	1.2	0	0	0	Syria uses part of the system. Maximum export capacity estimated at 500,000 b/d.
Iraq-Saudi phases 1 and 2	48/56	1.6	0	1.6	1.6	
Tapline [b]	30	0.5	NEGL	NEGL	NEGL	Deterioration of the line has reduced capacity of lines to 50,000 b/d.
Proposed						
Total				0-5	0.5-6.8	
Kuwait-Saudi				0.5	0.5	
Ganaveh–Bandar Behesti				0	0-2.0	
Ahvaz-Turkey				0	0-0.5	
Abu Dhabi–Al Fujayrah				0	0-0.8	
GCC line to Al Fujayrah				0	0-2.0	
GCC line to Salutiyat				0	0-1.0	

[a] Closed to Iraqi exports in April 1982.
[b] Closed to Mediterranean ports; terminates at Jordan's Az Zarqa refinery.

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million b/d by 1990 with the completion of projects to expand the Iraq-Turkey, Iraq-Saudi, and Saudi East-West pipelines. We do not foresee additional capacity being installed in the 1991-95 period, although the Saudi East-West pipeline is configured so that adding more pumps could raise its capacity another 2 million b/d.

Net Production Shortfalls

Taking into consideration the availability of surplus production capacity, we find that through 1990:

- A moderate disruption of about 5 million b/d could be completely offset in either the more dependent case or the less dependent case (figure 12).
- A major disruption of 14 million b/d would create a net shortfall ranging from about 9 million b/d in the more dependent case to 5 million b/d under the less dependent case.

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In the medium term—through 1995—the potential net production shortfalls are considerably more severe:

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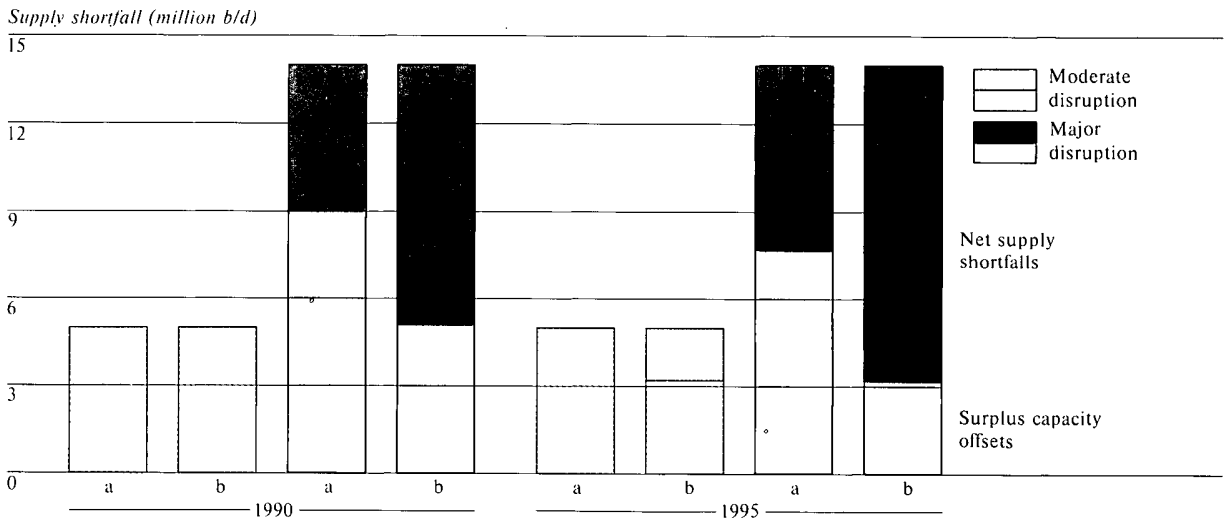
- A 5-million-b/d loss in capacity would cause nearly a 2-million-b/d net shortfall in the more dependent case, but could be completely offset by surplus capacity in the less dependent case.

Figure 12
Disruption Scenarios and Supply Availability, 1990 and 1995



[a] Less dependent.
[b] More dependent.

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- A 14-million-b/d loss in capacity would create a net shortfall of 6 million b/d in the less dependent case, and nearly 11 million b/d in the more dependent case.

In general, excess production capacity is likely to be sufficient to cover all but major disruptions in the near term, but by 1995 the availability of surplus capacity will play a more pivotal role in determining whether a disruption can be offset. In the medium term, a moderate disruption could be offset only by available surplus oil production capacity in the less dependent case. A moderate disruption under a more dependent case would create a net production shortfall of about 2 million b/d—comparable with the shortfalls experienced since 1970 that caused major market upheaval. In the event of a major disruption, the net shortfall under the more dependent case would be more than 70 percent greater than under the less dependent case.

Consumer Country Responses to Disruption

Consuming countries have several additional alternatives available to offset the net oil supply shortfall likely to result from a disruption during the 1990s.

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Stock Withdrawals

The use of strategic and government-controlled stockpiles is probably the most effective option available to mitigate the impact of a disruption:

- The US Strategic Petroleum Reserve (SPR) currently holds stocks of more than 506 million barrels, and a target level of 750 million barrels has been approved by the current US administration.

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Table 7
Refining Capability by Region

Million b/d

	United States	Europe	Arab Gulf	Other Exporters	Rest of World	Total Non-Communist World
1980						
Crude distillation	17.8	19.9	1.5	8.5	14.3	62.0
Fluid cat cracking	5.0	1.0	0.0	0.7	1.6	8.3
Cat reforming	3.7	2.5	0.1	0.5	1.7	8.5
1986 (estimated)						
Crude distillation	15.6	14.5	2.9	8.6	14.2	55.8
Fluid cat cracking	4.8	1.6	0.1	0.8	1.6	8.9
Cat reforming	3.4	2.1	0.3	0.8	1.5	8.1
1988/1990 (projected)						
Crude distillation	15.7	13.7	3.4	8.9	14.2	55.9
Fluid cat cracking	4.8	1.6	0.1	0.8	1.7	9.0
Cat reforming	3.4	2.0	0.3	0.8	1.6	8.1

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- Our allies in the Organization for Economic Cooperation and Development (OECD) own or control stockpiles totaling about 331 million barrels, including 201 million barrels in Western Europe (142 million barrels in West Germany plus smaller amounts in Italy, the Netherlands, Sweden, Denmark, Austria, and Greece), 129 million barrels in Japan, and 1 million barrels in New Zealand. In addition, Japanese companies hold compulsory oil stocks totaling about 150 million barrels.

US policy is to draw down the SPR in large volumes in the early stage of an oil supply disruption. At current levels, the SPR could be drawn down at a rate of more than 2.3 million b/d over a three-month period, and at gradually decreasing rates thereafter if the disruption lasted longer than three months. SPR oil could reach the market within 30 days of a Presidential decision to draw down stocks, and maximum drawdown rates could be achieved within 30 to 90 days, thereby reducing the impacts of a supply disruption. By 1995 a coordinated stock drawdown policy could further reduce the impacts of a supply disruption. Current levels of foreign government–controlled stocks are sufficient to provide additional supplies of about 1 million b/d for up to six months.

Because commercial stocks are usually in a normal operating range, they should not be counted on to help offset a disruption. Indeed, stockholders might actually try to build inventories at the beginning of a disruption, adding to demand and increasing upward pressure on prices in an already tight market. By 1995 these stocks could make up the expected net shortfall in a moderate disruption under the more dependent case and a substantial portion of the net shortfall in a major disruption under the less dependent case.

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Excess Refining Capacity

The drop in consumption during the 1980s has left major consuming countries with excess refining capacity that would facilitate crude reallocation during a supply cutoff. OPEC's move into refined product exports, coupled with prospects for some erosion in this surplus, however, raises questions about the market's flexibility to handle a large-scale reallocation in the future.

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The major changes in crude oil capability in the first half of this decade consisted of a 5.4-million-b/d reduction in West European capacity, a reduction slightly in excess of 2 million b/d in US and Caribbean capacity, and an increase in Arab Gulf capacity of 1.4 million b/d. Throughout the remainder of the 1980s, crude oil distillation capacity in the United States is not expected to change appreciably. However, the shift in crude oil capacity is expected to continue in Western Europe and the Middle East, with an additional 800,000-b/d reduction in West European capacity and a 500,000-b/d increase in Arab Gulf capacity.

Worldwide catalytic cracking capability increased significantly in the first half of this decade. This trend was a response to the increased availability of heavier crude oils on the world market as well as a response to the anticipated increase in the demand for lighter refined products. Although US capability actually decreased by about 200,000 b/d between 1980 and 1986, this decline was more than offset by the rest of the non-Communist world's installation of about 800,000 b/d of catalytic cracking capacity. No major increase in worldwide cracking capability is anticipated for the remainder of the decade. Oil industry experts generally agree that the worldwide refining environment that is expected to exist by the end of the decade will have considerably greater refining flexibility for creating a lighter product barrel by converting residual fuel oil rather than crude oil into light products.

By the end of this decade the share of gasoline and middle distillates will have increased significantly in the total world trade of refined products. The Middle East is expected to move ahead of Latin America as the world's largest refined products export region. The centrally planned economies are expected to fall from second largest to third. Western Europe, because of its massive refinery shutdowns throughout the 1980s, is expected to replace the United States as the largest importer of refined products.

A major disruption of oil supplies in 1990 would not necessarily result in a total loss of refined product exports from Arab Gulf nations. Saudi Arabian export refineries on the Red Sea could keep about 500,000 b/d of product flowing from Arab Gulf nations. The reduced level of oil demand brought about by rising petroleum prices would no doubt result in shifts in regional refinery utilizations as well as shifts in trade patterns. With the demand for light refined products being less responsive to price increases than the demand for residual fuel oil, the requirement on refiners would be to produce a greater share of light products from a barrel of crude oil. This situation would favor those refiners that have significant downstream processing capability.

Table 8
Current Fuel Switching Potential

Million b/d

	United States	Other IEA	Total IEA
Total	**0.42-1.19**	**0.19-0.52**	**0.61-1.71**
Electric utilities	0.02-0.08	0.19-0.26	0.21-0.34
Industrial sector	0.30-0.65	0-0.26	0.30-0.91
Transportation	0.10-0.21		0.10-0.21
Residential/ commercial	0-0.25		0-0.25

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Demand Restraint Measures

Efforts to offset the impact of a supply shortfall by reducing demand have proved ineffective in past crises. Consumers tend to hoard in an emergency, especially when considerable uncertainty arises concerning the severity of the disruption and prospects for timely offsetting of supplies from stocks and excess production capacity. Moreover, unlike stock withdrawal, demand restraint measures do not significantly mitigate the economic impact of a disruption.

Interfuel Substitution

The potential for interfuel substitution will depend upon dual fuel capabilities and the availability of alternative fuels. At present the switching capability from oil in International Energy Agency (IEA) member countries is estimated at about 0.6-1.7 million b/d (table 8). Most of the switching capability in electric

Table 9
Consumer Country Response Potential

Million b/d

	Moderate Disruption				Major Disruption			
	1990		1995		1990		1995	
	Less Dependent	More Dependent	Less Dependent	More Dependent	Less Dependent	More Dependent	Less Dependent	More Dependent
Net shortfall/surplus	4	0.1	2.7	−1.8	−5.0	−8.9	−6.3	−10.8
Government stocks	3	3	3.5	3.5	3	3	3.5	3.5
Of which:								
United States	2	2	2.5	2.5	2	2	2.5	2.5
Other	1	1	1	1	1	1	1	1
Additional fuel switching and conservation required	0	0	0	0	2	5.9	2.8	7.3

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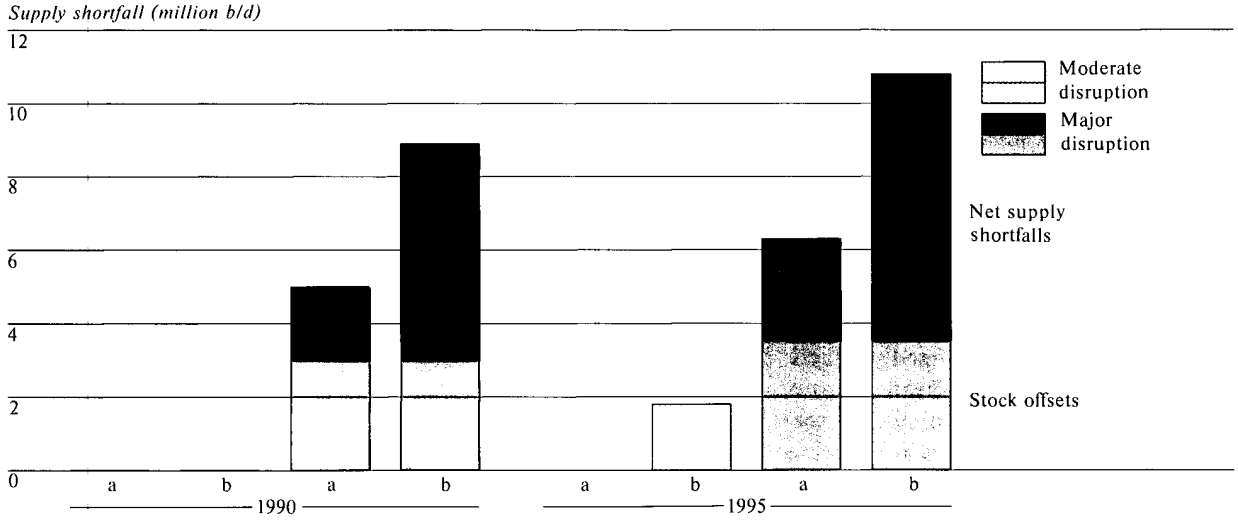
Figure 13
Consumer Country Response Potential, 1990 and 1995



[a] Less dependent.
[b] More dependent.

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utilities and the industrial sector is to natural gas. The switching in the transportation sector is to alcohol fuels, and the switching in the residential/commercial sector is to wood and electric space heaters. Given the outlook for the coal and gas markets, we estimate the potential for easily switching from oil will be likely to erode over the next decade. Prices would probably have to rise, however, to encourage users to switch to alternative supplies. Available excess gas capacity would be more limited if a disruption occurred during the peak winter demand season.

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On balance, it appears that stocks and other available options are sufficient to offset all but major disruptions under both the more and the less dependent cases in 1990 and 1995 (table 9 and figure 13). Because most industry analysts believe that surplus capacity of 2-3 million b/d is necessary to keep the oil market stable, some offsets probably would be needed under a moderate disruption in 1995 under the more dependent case. Some combination of fuel switching and demand restraint will be required to offset a major disruption in both the 1990 and 1995 periods. In any event, prices would probably rise to bring at least part of excess oil capacity onto the market and cause the necessary fuel switching and conservation required to balance the market. Only government-controlled stocks could be counted on in the absence of higher prices.

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